Bootstrapping evolvability for inter-domain routing with D-BGP

Raja Sambasivan

David Tran-Lam, Aditya Akella, Peter Steenkiste

This talk in one slide

Q **What evolvability features needed in any inter-domain protocol?**

A **Pass-through support**

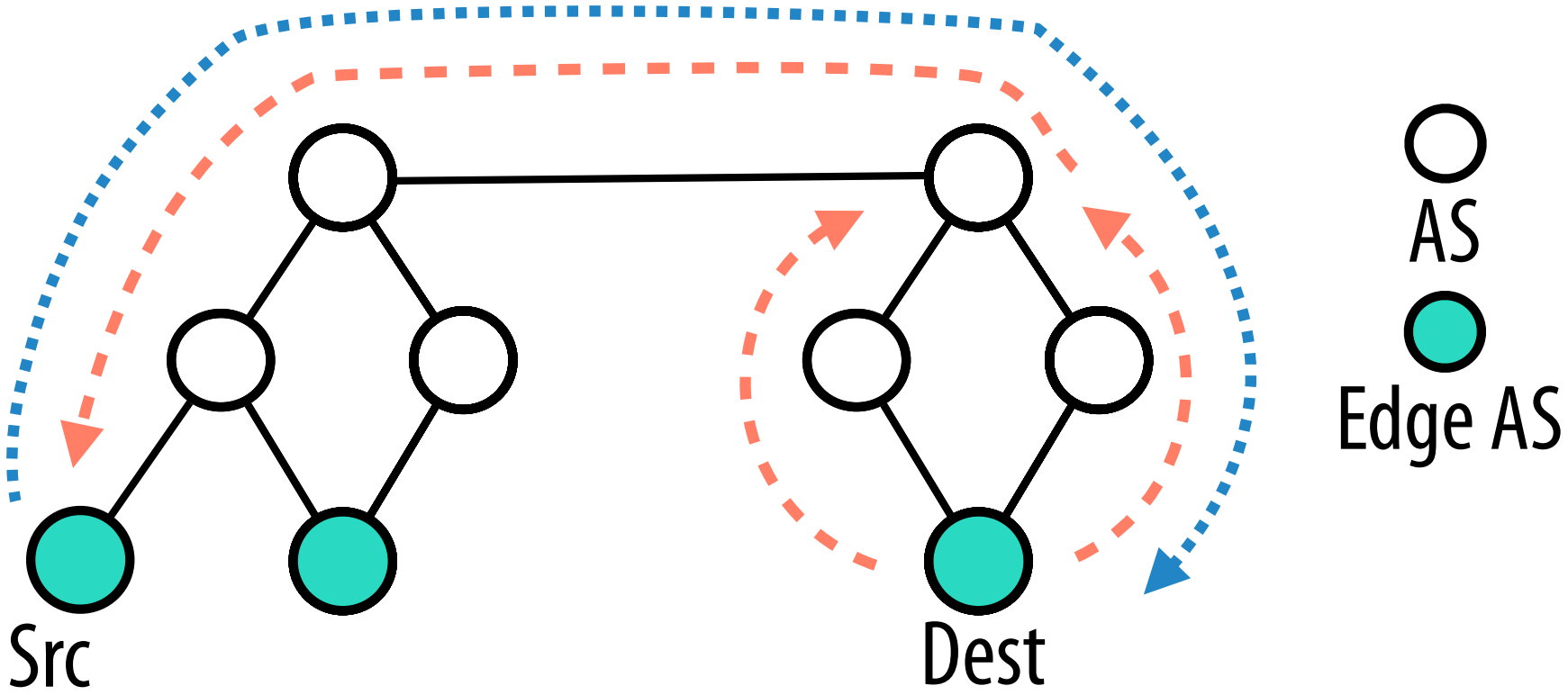
Multi-protocol structure

D-BGP (BGP w/features): rich, evolvable Internet

The inter-domain routing infrastructure

Allows access to Internet's content (e.g., Gmail)

Today, composed of a single protocol, BGP



BGP has many well-known issues

Cannot limit ingress traffic

High convergence times

No QoS

Only one best path

ASes can be spoofed

⋮

Proposed solutions

Wiser [NSDI'07]
SCION [SP'11]
NIRA [CCR'03]
HLP [SIGCOMM'05]

R-BGP [NSDI'07]
MIRO [SIGCOMM'06]
Arrow [SIGCOMM'14]
⋮

BGPSec [IETFv8]
Pathlets [SIGCOMM'09]
EQ-BGP [AINA'06]

BGP has many well-known issues

Cannot limit ingress traffic

High convergence times

No QoS

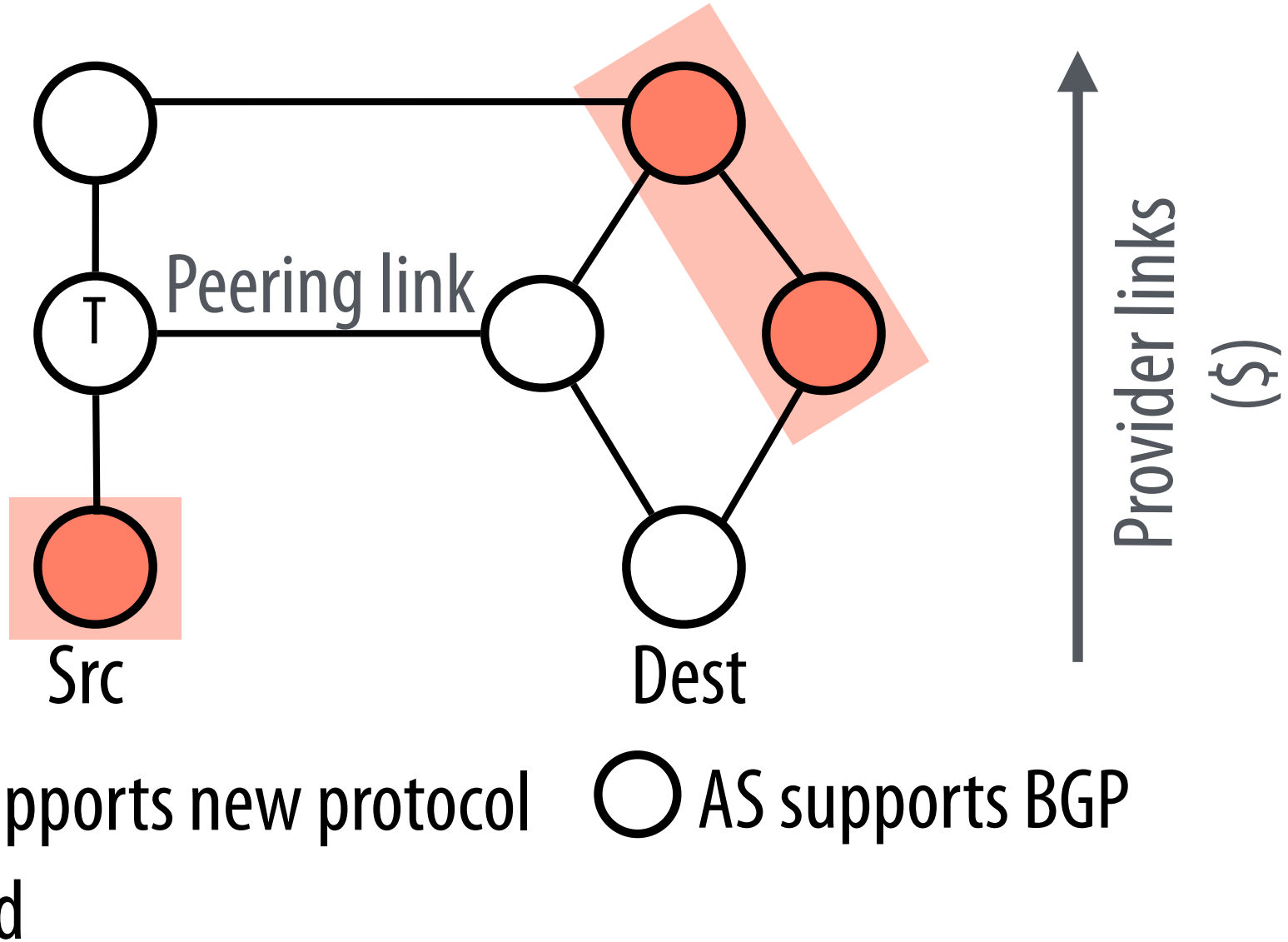
Only one best path

ASes can be spoofed

⋮

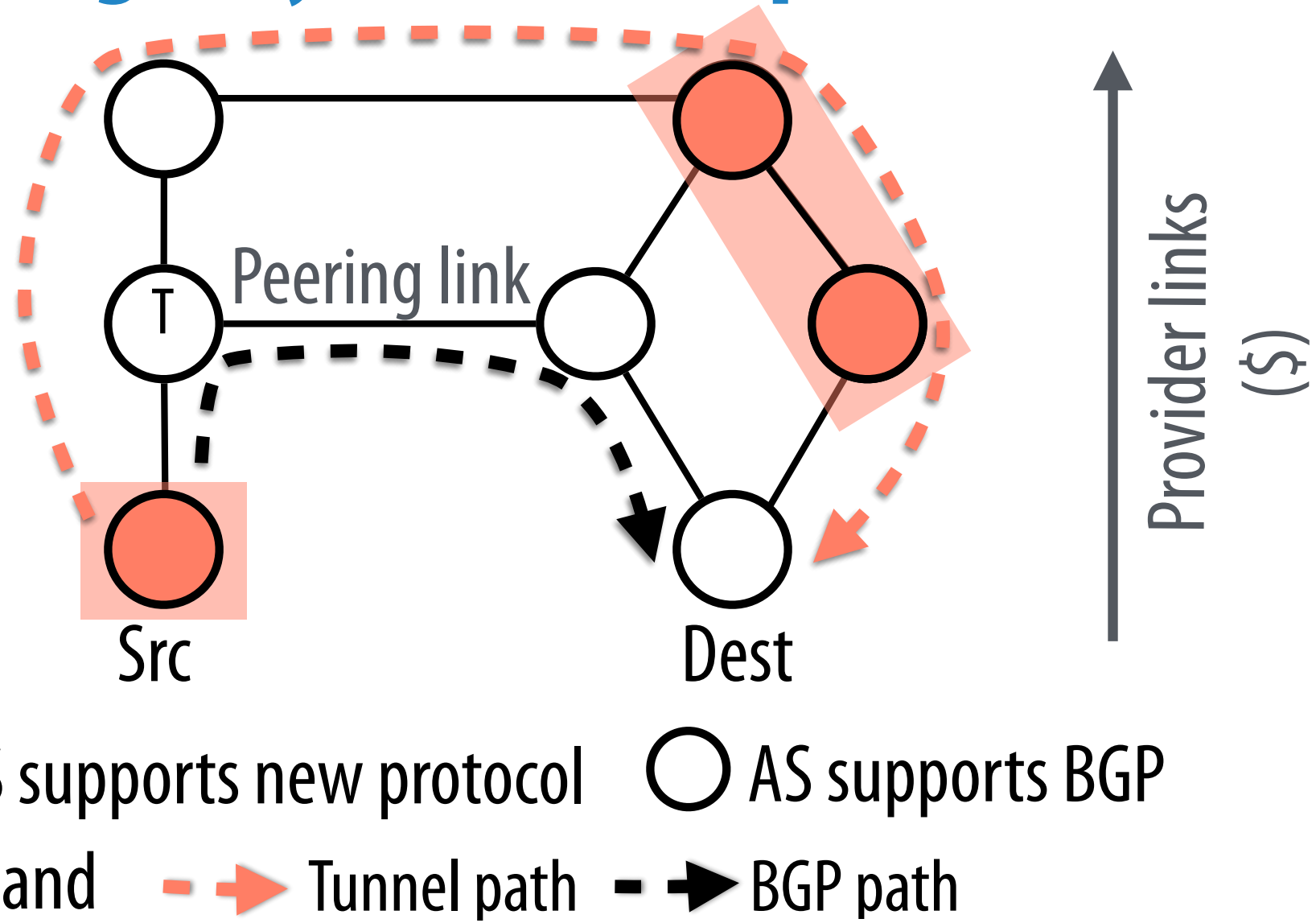
BGP is rigid: requires neighbors to use it

Rigidity results in isolated islands



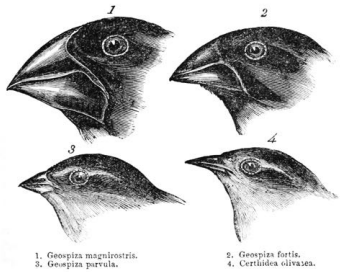
Isolation dis-incentivizes deployment

Skirting rigidity with data-plane tunnels



Incentivizes non-deployers to fight evolution

Key contributions



The two modest evolvability features

Pass-through support **Multi-protocol structure**

Makes data-plane tunneling optional

D-BGP, which is not far from BGP

Only Required 900 lines of code

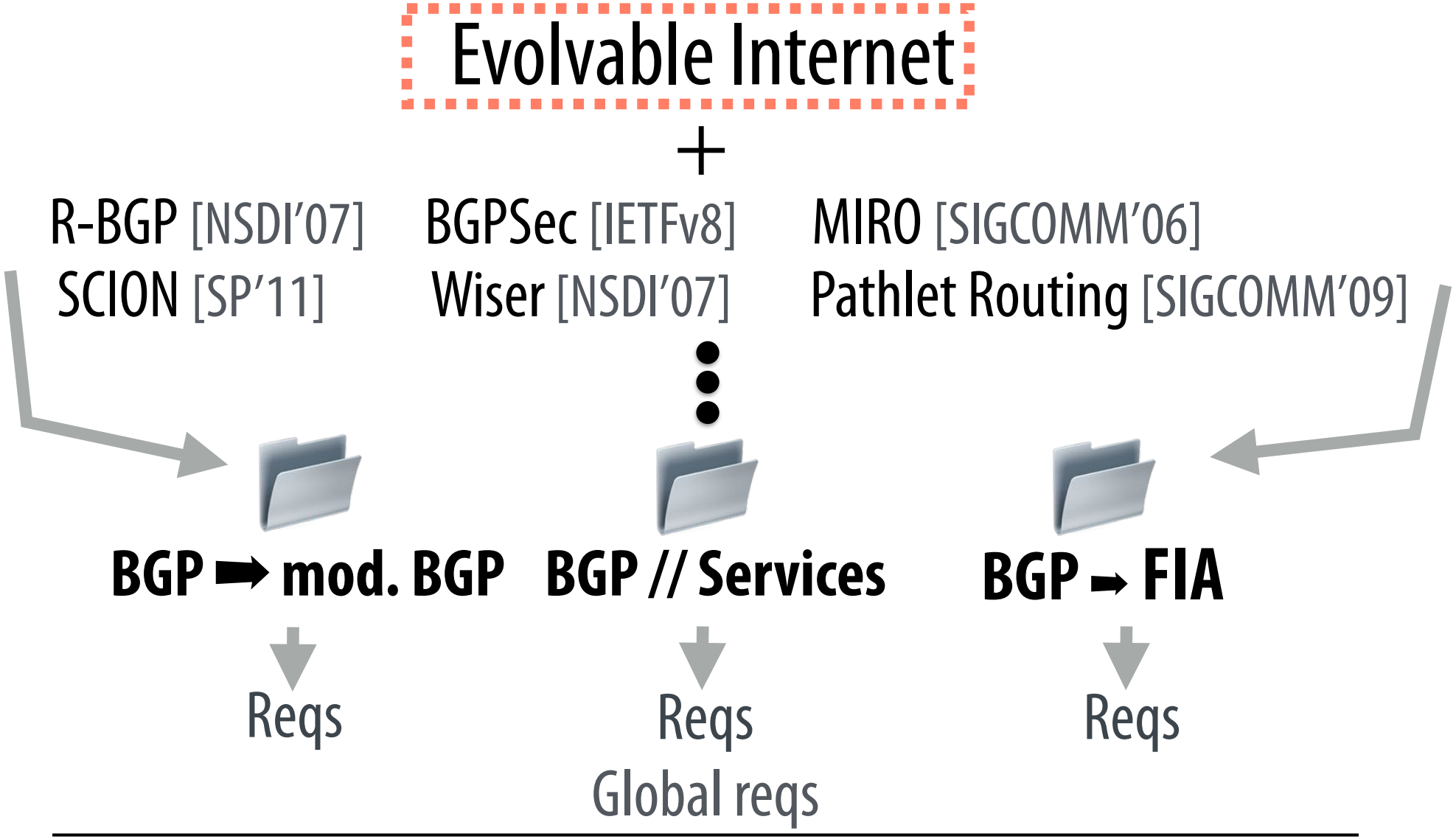
BGP already includes pass-through support

Characterization of D-BGP's benefits

Enables a rich Internet w/many protocols

Incentivizes adoption by accelerating benefits

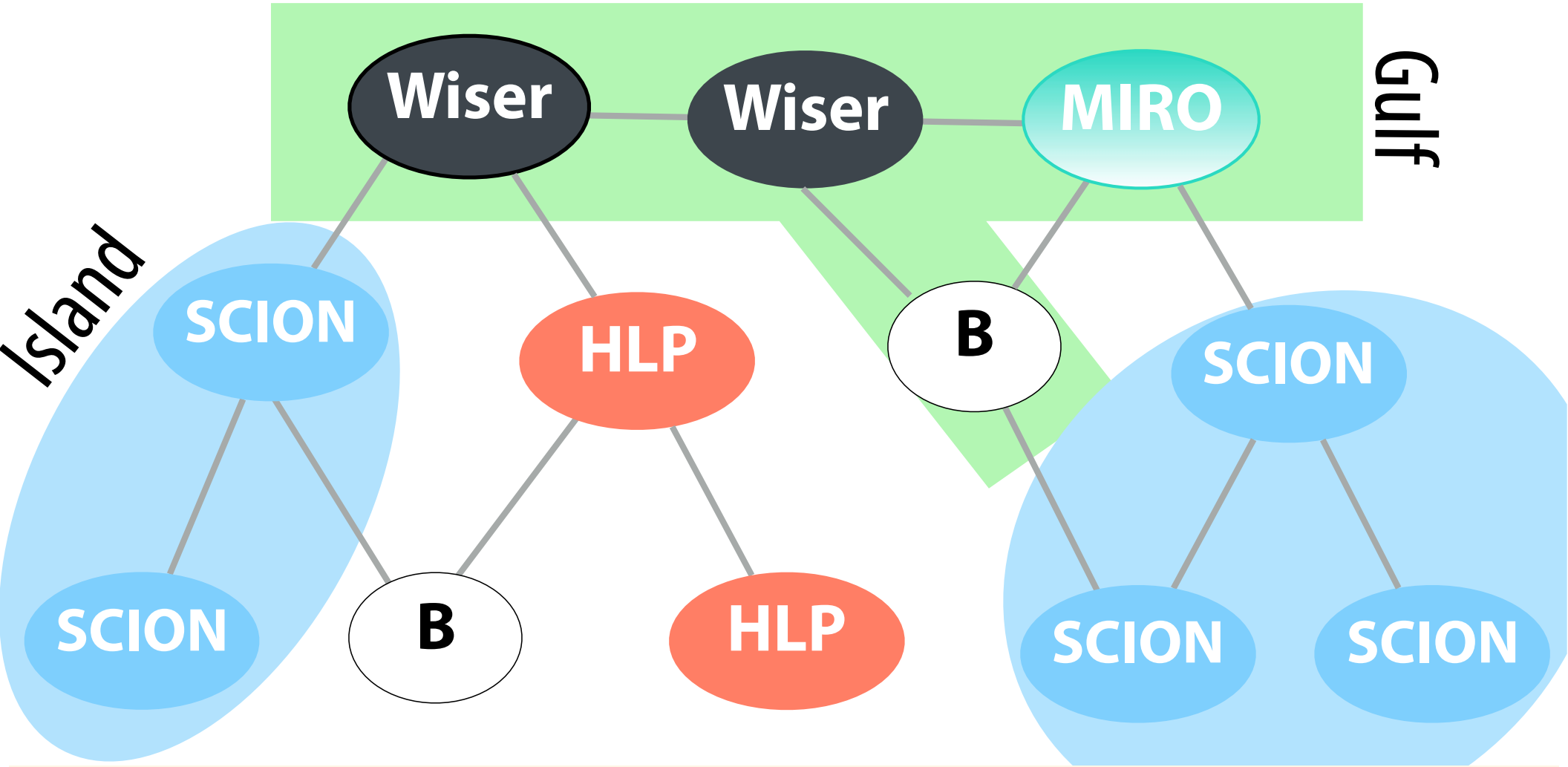
How we identified evolvability features



Pass-through support (provided by BGP)

Multi-protocol structure

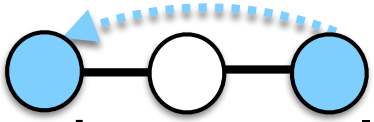
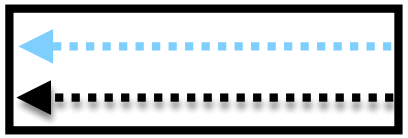
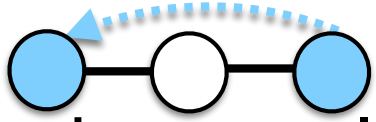
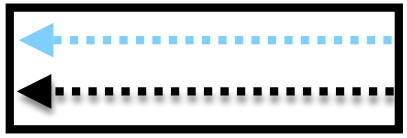
An evolvable Internet



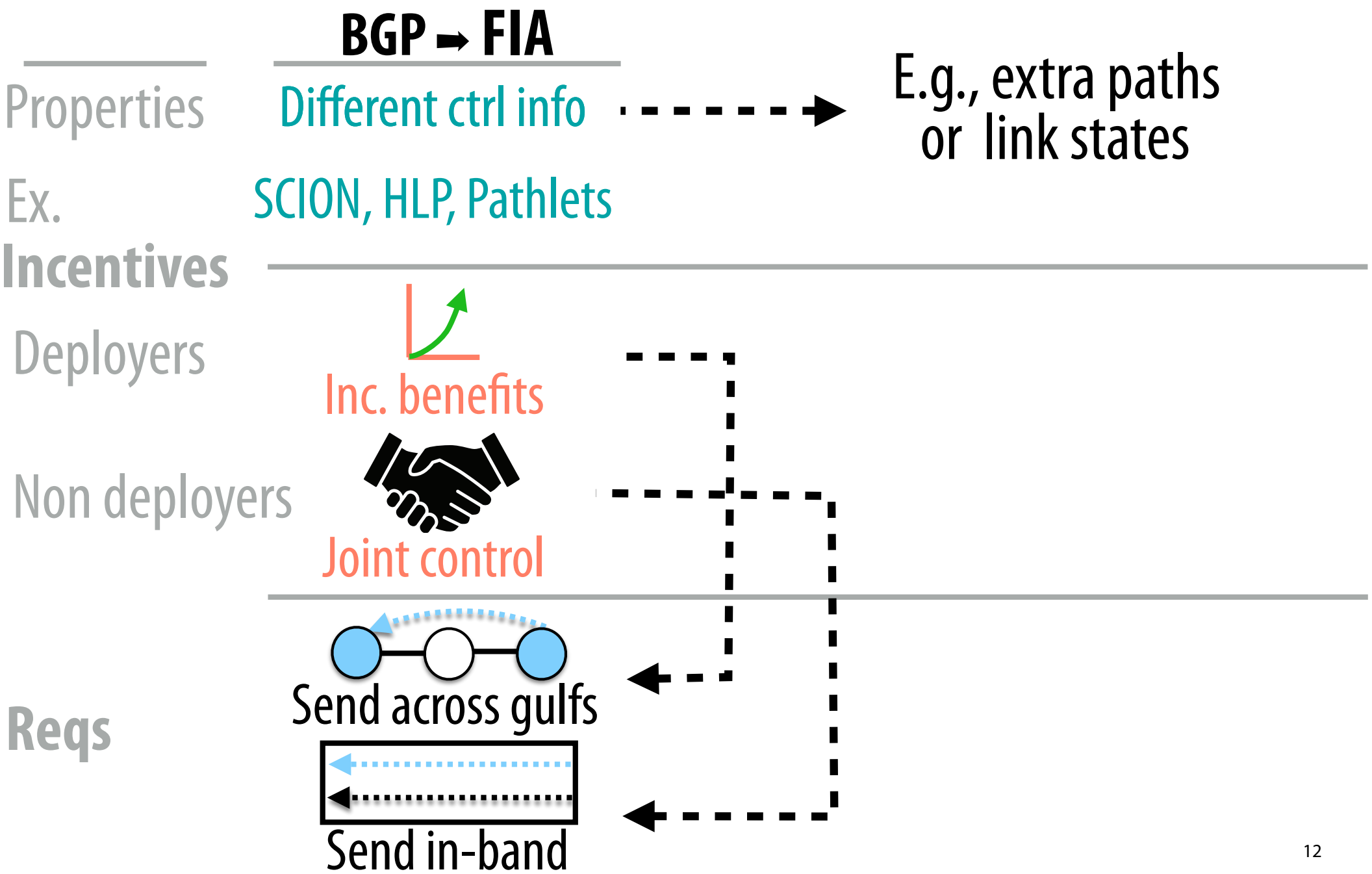
Runs many routing protocols

All ASes support a shared baseline (B)

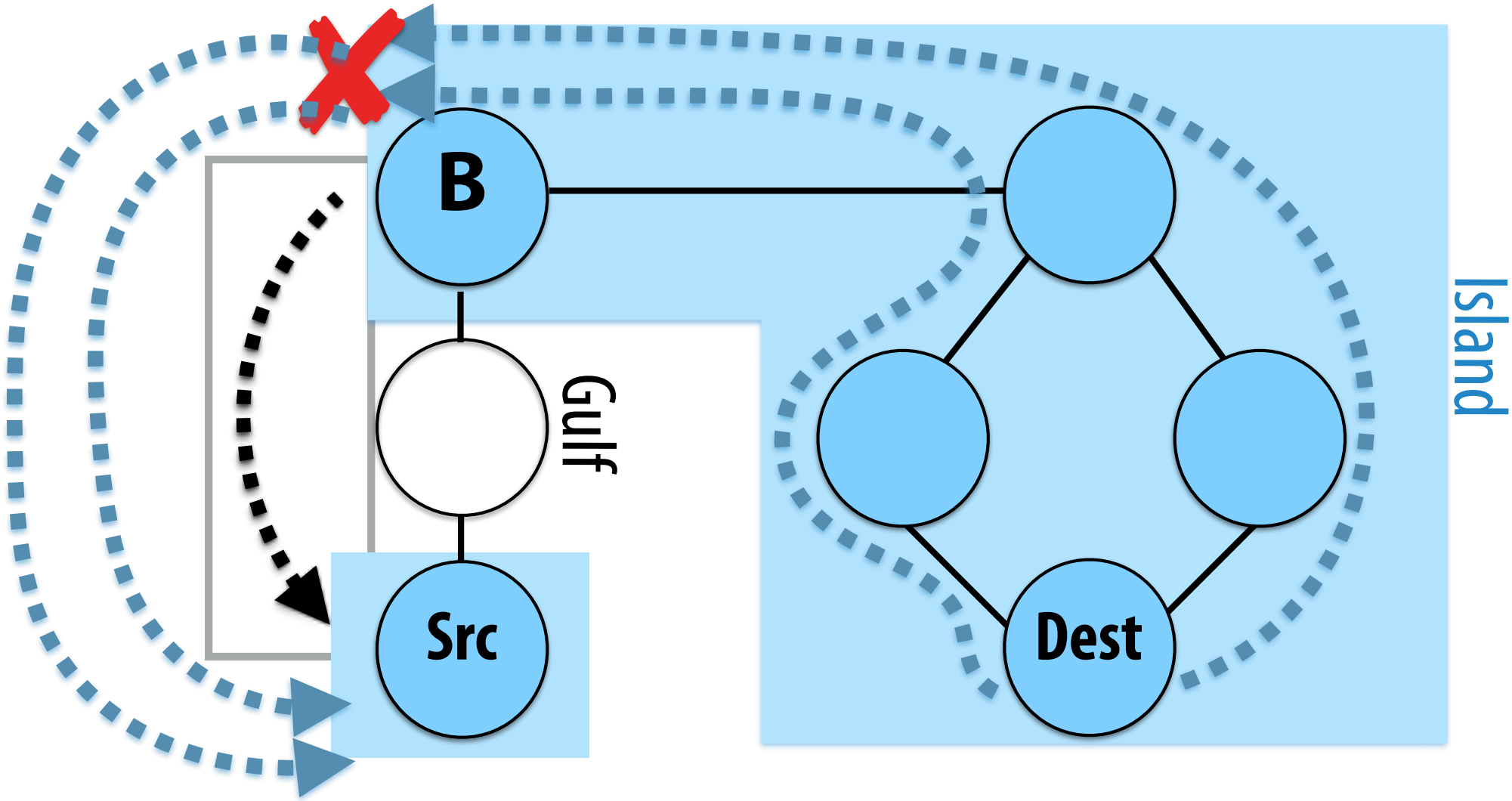
Taxonomy of evolvability scenarios

	BGP ➡ mod. BGP	BGP // Services	BGP ➡ FIA
Properties	Extra ctrl info	*	Different ctrl info
Ex.	Wiser, R-BGP	MIRO, Arrow, *	SCION, HLP, Pathlets
Incentives			
Deployers	 Inc. benefits	 Profits	 Inc. benefits
Non deployers	 Joint control	 Future profits	 Joint control
Reqs	 Send across gulfs  Send in-band	 Enable discovery	 Send across gulfs  Send in-band

Evolvability scenarios (FIA)



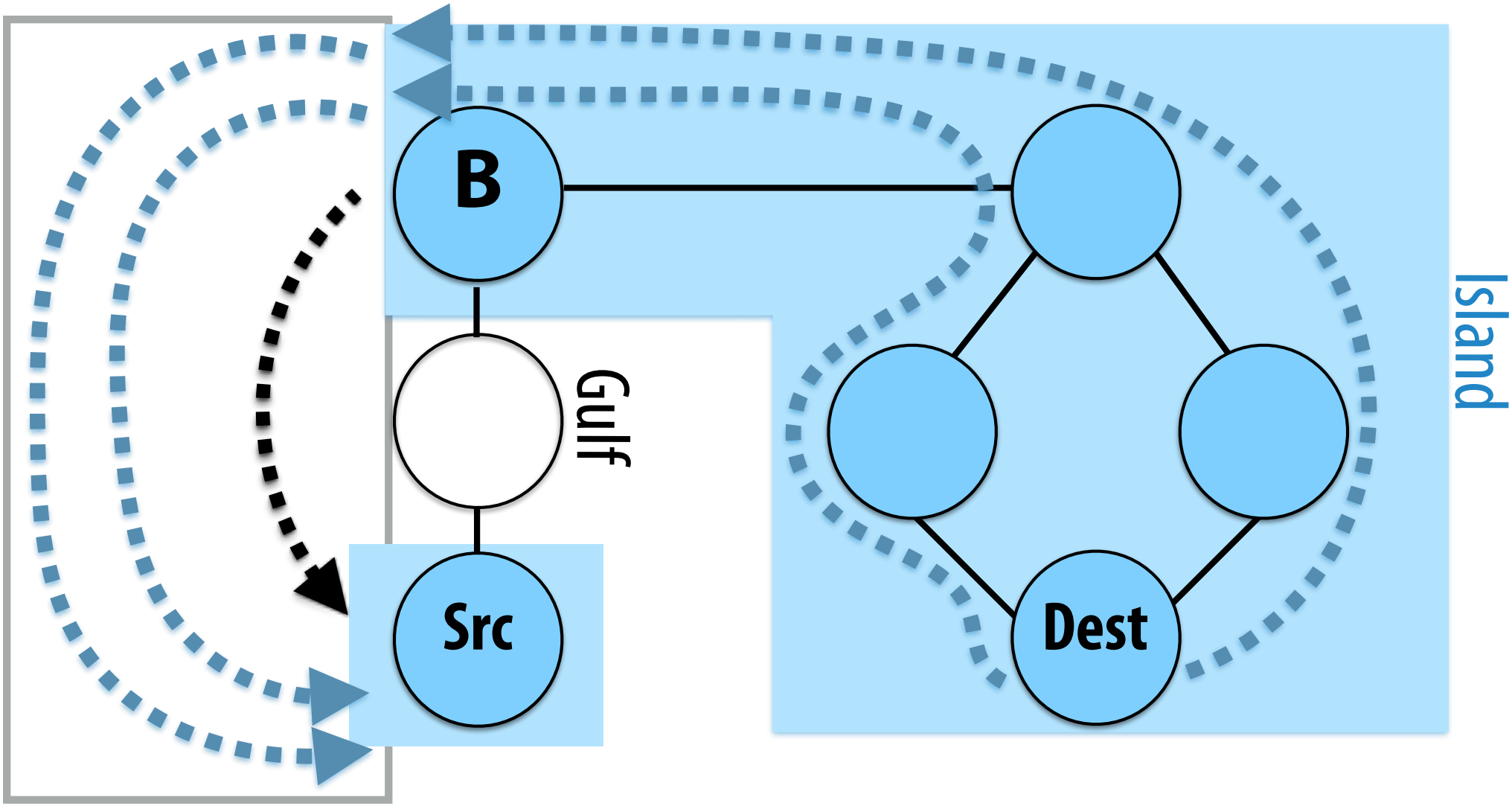
Deploying SCION, a FIA protocol



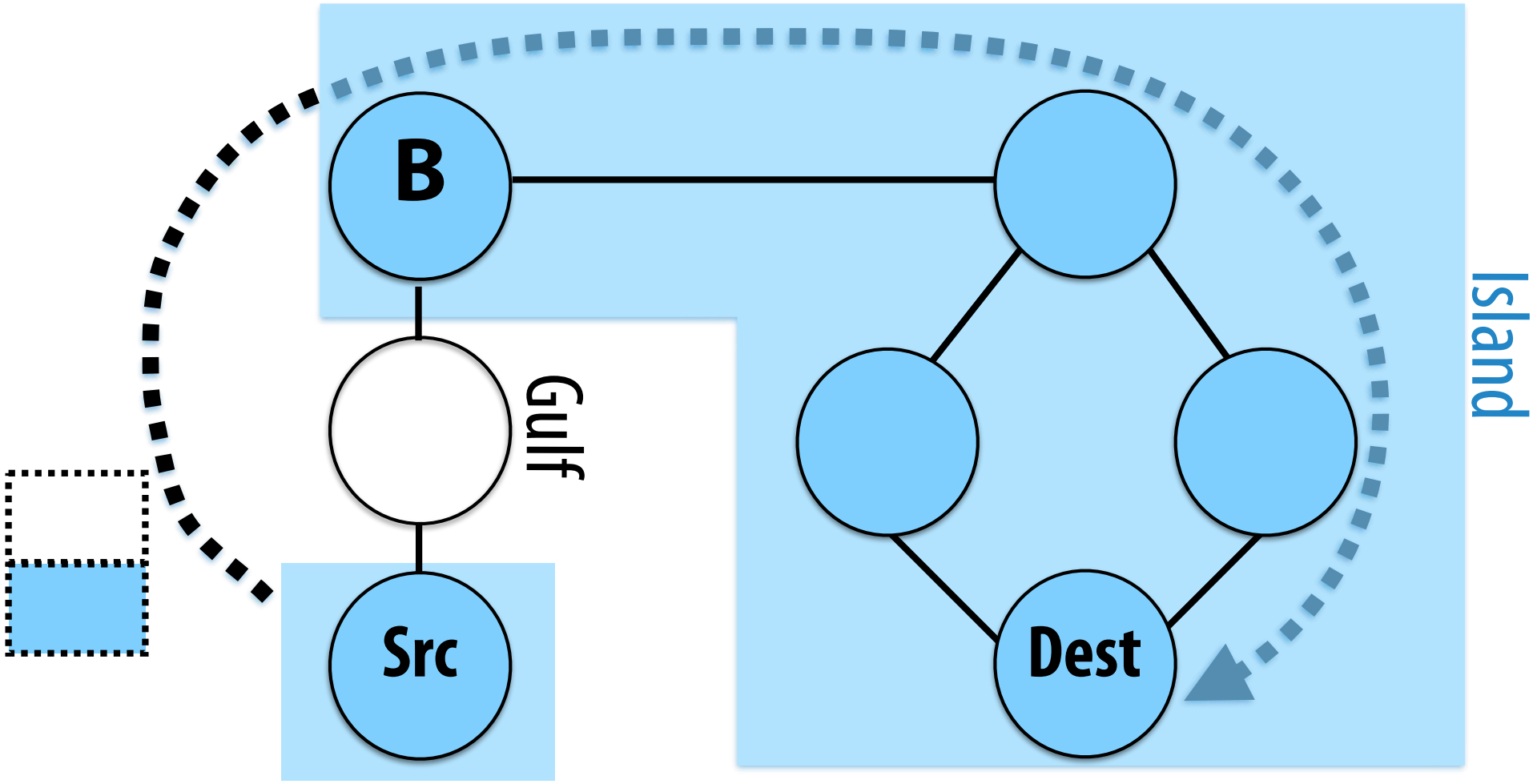
Baseline advertisement

Packet hdr (IP + SCION)

Deploying SCION, a FIA protocol



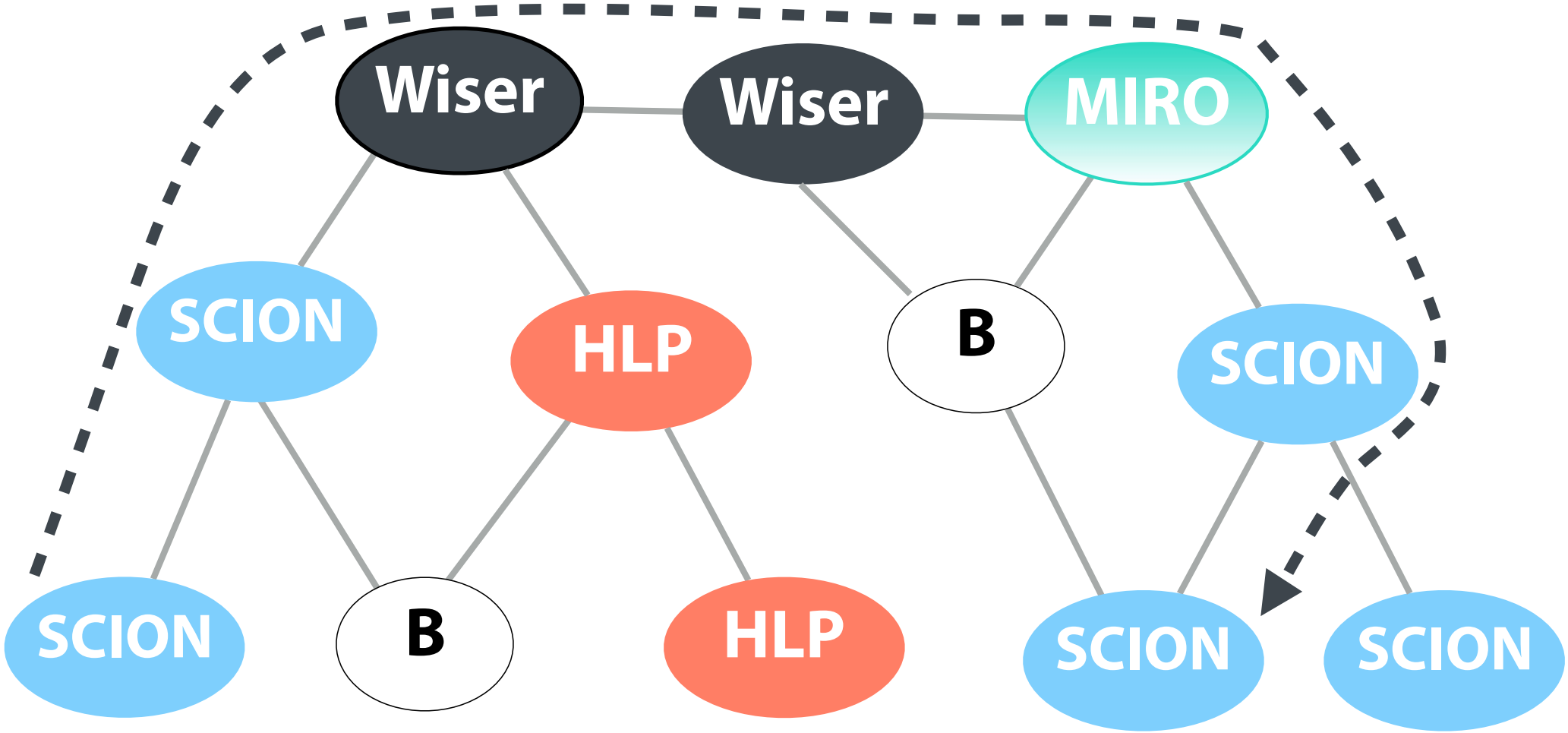
Deploying SCION, a FIA protocol



Baseline advertisement

Packet hdr (IP + SCION)

Global reqs for an evolvable Internet



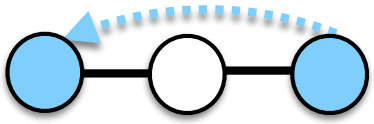
Inform islands about protocols on paths

Provide common denominator for e-e paths

Features

Requirements

Pass-through support

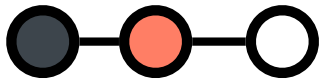


Disseminate across gulfs

Disseminate in-band

Enable discovery

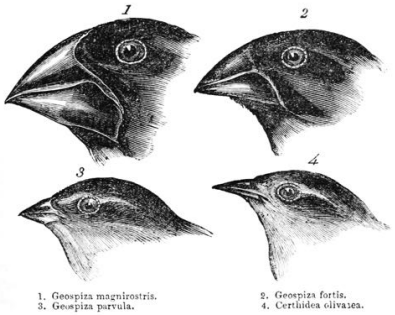
Multi-protocol data structure



Inform islands about protocols on paths

Provide common denominator for e-e paths

Outline



Evolvability features

D-BGP design

D-BGP eval

D-BGP overview

BGP advs
with
Multi-protocol structure

Integrated advs (IAs)

BGP processing
with
IA support & pass-through

IA processing

Island

Island

D-BGP's integrated advertisements

Dest. address: 128.2.42.52/24

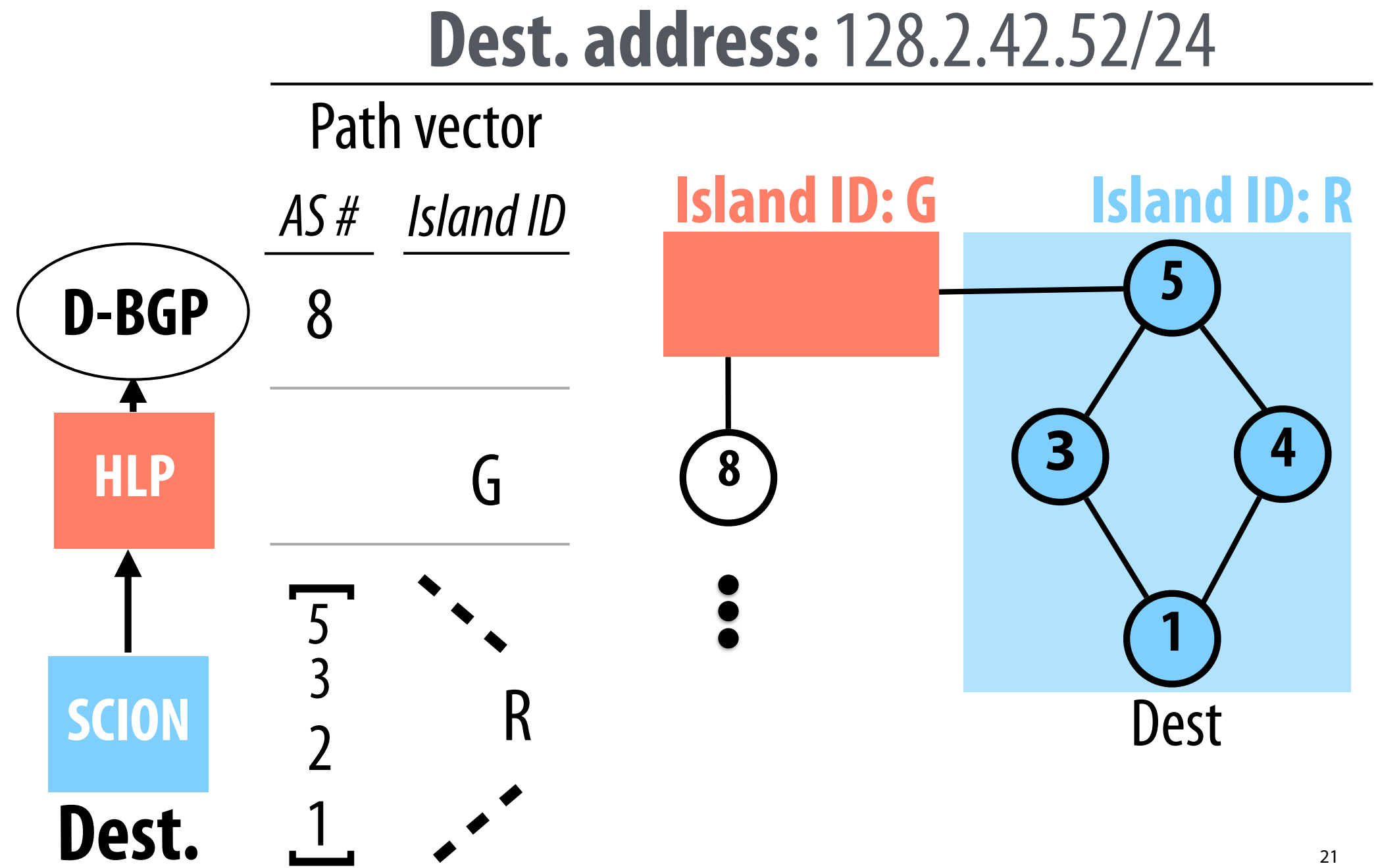
Path vector

AS # *Island ID* - - - → Abstracts within-island paths

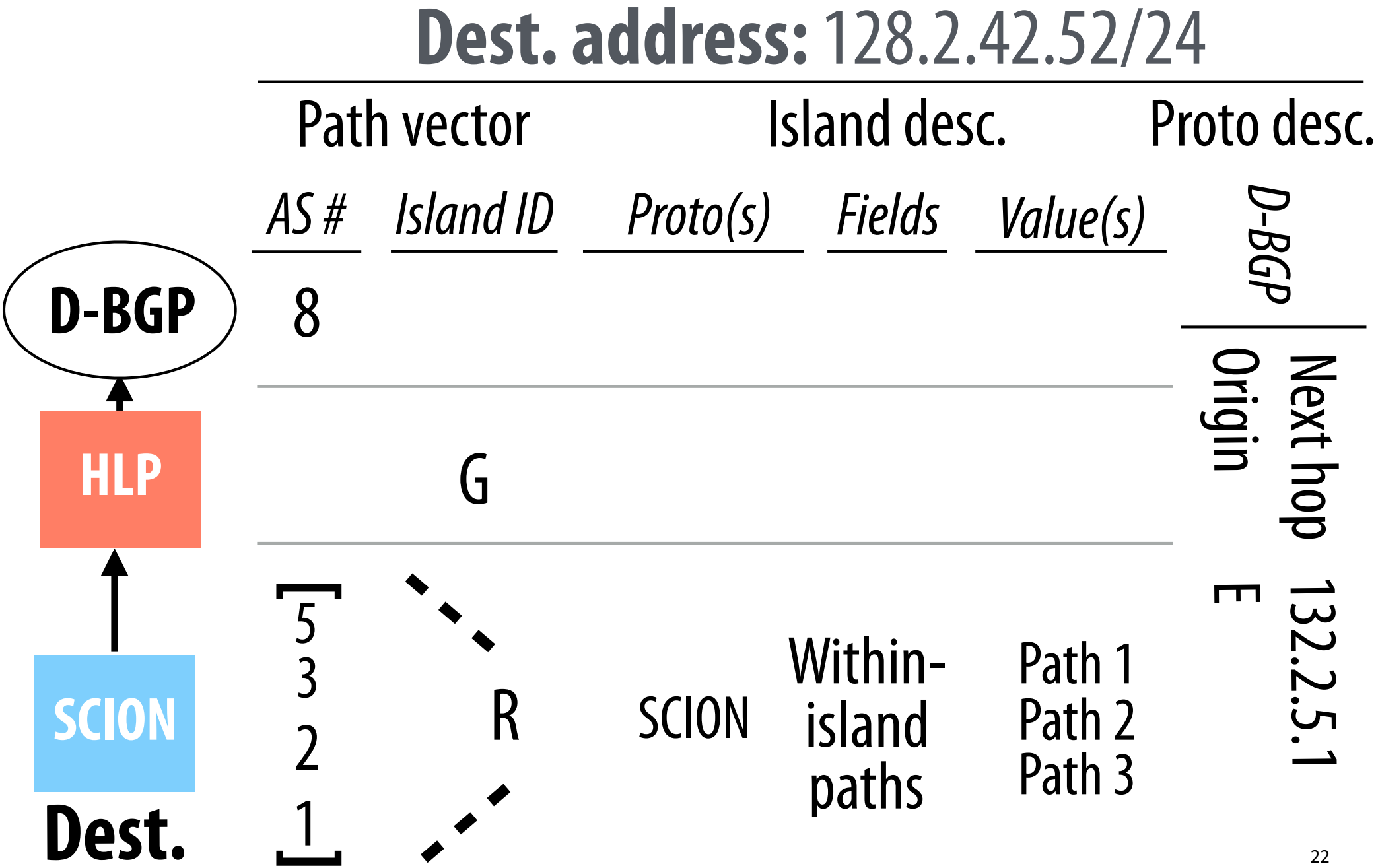
⌐ - - - - → Prevents ASes from discounting end-to-end paths that include within-island paths

⌙

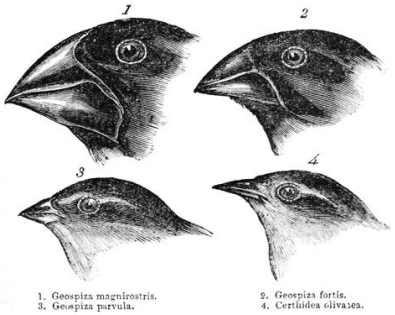
An IA for a path



An IA for a path



Outline



Evolvability features

D-BGP design

D-BGP eval

- Accelerating benefits
- Control-plane overhead
- Quagga implementation
- New-protocol deployments

Accelerating benefits evaluation

Compared deployment in an Internet with:

 D-BGP

 BGP

Explored benefits as function of adoption

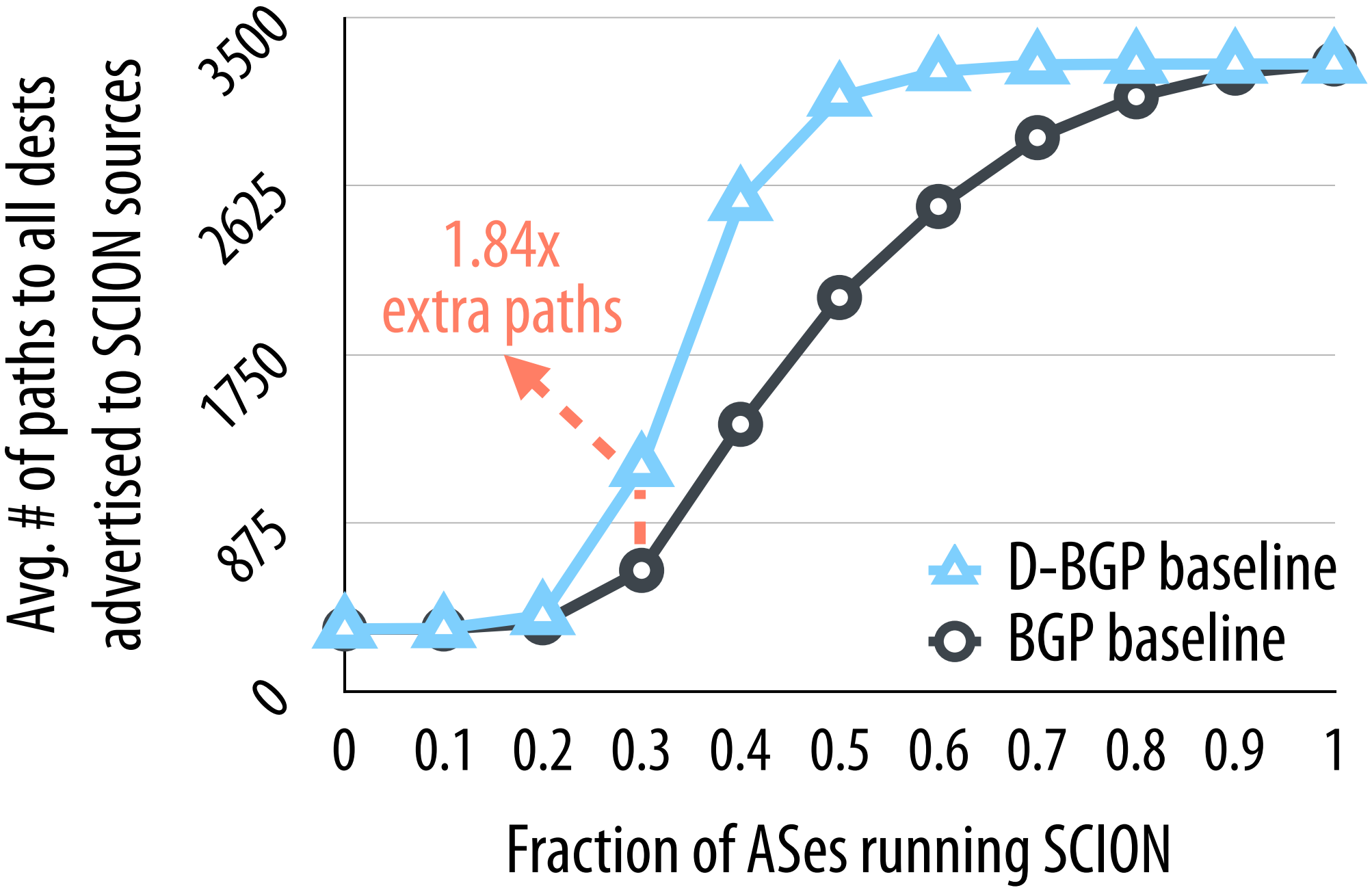
E.g., # paths to dests at upgraded edge domains

Experiments done in simulation

Used Brite [Mascots'01] to generate 1,000-node topology

Used modified routing simulator [SIGCOMM'14]

D-BGP accelerates benefits for SCION



Summary

- BGP's rigidity → Evolvability
- Two features sufficient for evolvability
- D-BGP provides large evolvability benefits